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(54) Process for dry fractionation of fats and oils

(57) A process for the dry fractionation of fats and oils by allowing a fat-and-oil feedstock having SFI at 20°C of, at least, 15 to stand to form fat crystals and to obtain cakes containing fat crystals and subjecting the cakes to separation of solids from the liquid phase wherein the fat-and-oil feedstock to be allowed to stand is pre-cooled to a temperature of, at the highest, 3°C higher than that of a cooling medium used for the crystallization.

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Description

The present invention relates to a process for the dry fractionation of fats and oils, especially laurin fats and oils.

Fats and oils having high SFI (solid fat index) are effectively utilized by fractionation thereof into high and low melting point fractions. In general, high melting point fractions are more costly than low melting point fractions. In fact, for example, in the case of palm kernel oil (PKO), since its high melting point fraction (PKS) is useful as a raw material for the production of a cocoa butter substitute (CBS) for example, PKS is marketed at a higher price than a low melting point fraction (PKL) of PKO, and PKL is even cheaper than PKO *per se* as a raw material for the fractionation. Then, for the fractionation of fats and oils having high SFI, in many cases, procedures have been attempted to increase the yields of high melting point fractions as much as possible efficiently.

At present, a representative process for the fractionation of palm kernel oil employed in the Malay Peninsula region is dry fractionation, that is, fractionation of fats and oils without using any solvent or detergent.

In a typical dry fractionation, PKO is pre-cooled to about 27°C and distributed into many trays, followed by standing at 18 to 21°C for about 10 hours to crystallize, wrapping up the resultant cakes containing fat crystals with a filter cloth and subjecting the wrapped cakes to filtration under pressure (with a hydraulic press) to separate solids from a liquid phase ("SPECIALTY FATS VERSUS COCOA BUTTER" by Wong Soon, 1991). Hereinafter, this process is referred to as the conventional process.

In the conventional process, for increasing the yield of PKS, it is necessary to sufficiently carry out the standing phase of pre-cooled PKO distributed into trays to increase the amount of fat crystals formed. On the other hand, this causes difficulties in filtration (separation of the liquid phase from solids) and, in order to recover fat crystals having good quality, it is necessary to press the cakes containing the fat crystals under high pressure with a hydraulic press for a long period of time. However, there is a certain limit to the increase in yield of PKS by this procedure. Also, the improvement of the conventional process is directed toward solving the problems caused by intensive labor type steps as described below rather than increasing in the yield of PKS.

Specifically, the conventional process has been widely employed because of the low costs of its facilities. However, a large number of trays are used in the standing step for crystallization (it is said that a large number of trays as many as 10,000 to 20,000 are required for facilities treating 100 tons of PKO per day). This step is very simple and the trays are merely allowed to stand in a large room or space (e.g. on shelves). Then, non-uniform atmospheric temperatures of the respective trays cannot be avoided and to control crystallization temperatures and time is difficult, which results in the problem that the quality of the products is apt to be inconsistent. In addition, there is the defect that the filter cloth is apt to be worn out due to high pressure.

Furthermore, when the steps from standing to filtration under pressure are studied in detail, various steps such as those for releasing the cakes containing fat crystals which are in solid or semi-plastic state from respective trays, wrapping them individually, transferring the wrapped cakes and then laying them up in a hydraulic press are required. However, these respective steps can hardly be automated and a great deal of labor is required. In fact, it is said that 70 to 80 people are required for the facilities for treating 100 tons of PKO per day. Therefore, from an economic viewpoint, the conventional process could no longer be practised except in a region where considerably cheaper manpower is available.

If it were possible to transfer the cakes containing fat crystals after crystallization, an automatic filter press could be used instead of a hydraulic press because the cake slurry could be transferred into the filter press through a pipeline and be filtered by the filter press. When a filter press can be used, such intensive labor steps as wrapping the cakes with a filter cloth and laying them up in a hydraulic press can be eliminated. Then, some activities have been attempted employing a filter press. However, even if the cakes after full crystallization are crushed or smashed, a slurry having sufficient fluidity cannot be obtained and therefore the fatty material is difficult to transfer through a pipeline. Accordingly, at present, the amount of fat crystals formed has to be controlled to maintain fluidity of the slurry after crushing. That is, procedures for saving manpower are attempted to the detriment of the yield of PKS.

In view of these circumstances, one object of the present invention is to provide an economic process for the dry fractionation of fats and oils which can save a great deal of manpower by employing a filter press without sacrificing the yield of PKS.

This object as well as other objects and advantages of the present invention will become apparent from the following description.

The inventors of the present Patent Application have studied intensively based on a recognition that to employ a filter press in the step for separating solids from the liquid phase is indispensable to save manpower and to obtain consistent quality of fractionated products. As a result, it has been found that, by recycling a certain amount of a fractionated low melting point fraction obtained in the separation step and mixing it with a fat-and-oil feedstock, even if a sufficient amount of fat crystals are formed, a slurry of cakes containing the fat crystals and having good fluidity can be obtained and, surprisingly, yields higher than that of the conventional process can be achieved. Thereby, it has also been found that the pre-cooling temperature can be lowered to about crystallization temperature and the crystal-

lization time can be substantially reduced. Thus, the present invention was completed.

Specifically, according to the present invention, there is provided a process for the dry fractionation of fats and oils which comprises allowing a fat-and-oil feedstock having SFI at 20°C of, at least, 15 to stand to form fat crystals and to obtain cakes containing fat crystals and subjecting a slurry of the cakes to separation of solids from the liquid phase, said fat-and-oil feedstock which is to be allowed to stand being precooled to a temperature of, at the highest, 3°C higher than that of a cooling medium used for the formation of fat crystals.

Fat-and-oil feedstock

The fat-and-oil feedstock to be used in the present invention is one having a high SFI at 20°C, especially an SFI at 20°C of 15 or higher, preferably 20 or higher, more preferably, 30 or higher. Examples thereof include laurin fats and oils and hydrogenated fats and oils. A typical example of laurin fats and oils is palm kernel oil (PKO). In the present invention, the fat-and-oil feedstock is preferably mixed with a low melting point fraction and the fractionated low melting point fraction obtained from the separation step can be recycled for this purpose. A preferred proportion of the low melting point fraction to be mixed is 30% by weight or more preferably, 45% by weight or more based on the total weight of the resulting mixture of the fats and oils feedstock and the low melting point fraction. When the mixing proportion is smaller than this range, the desired slurry as described hereinafter cannot be prepared and the desired advantages of the present invention are hardly expected. From a technical viewpoint, there is no upper limit of the mixing proportion. However, when the mixing proportion is very large (e.g., more than 70% by weight), it is undesirable because the increase in the loading is accompanied by an increase in the costs of the facilities.

A technique of recycling a liquid oil to a fat-and oil feedstock is disclosed by JP-A 60-108498. However, this technique relates to the effective production of a liquid oil from a fat-and-oil feedstock having a low SFI and is completely different from the present invention where the yields of solid fats are improved.

Pre-cooling

To prevent wintering, the fat-and-oil feedstock is normally kept in a molten state by warming in a tank, for example, at 40°C or higher in the case of PKO. This is pre-cooled, for example, with a heat exchanger. The pre-cooling can be carried out with any known heat exchanger to a temperature of, at the highest, 3°C higher than, preferably 1°C higher than the temperature of formation of fat crystals by standing (cooling medium temperature). More preferably, the pre-cooling is carried out to a temperature of equal to or desirably, 1°C lower than the crystallization temperature, or lower. The pre-cooling is preferably carried out at a temperature of, at the lowest, 5°C lower than the crystallization temperature, at which no clear crystallization has taken place, for a relatively short period of time.

For adjusting the pre-cooling temperature to the above-described temperature, in practice, recycling of a fractionated low melting point fraction is required. When the recycling is not carried out, blockage of the heat exchanger is caused by growth of crystals with the lapse of continuous treatment because of the high concentration of crystallizable components, which makes a reliable cooling operation difficult.

Allowing to stand for the formation of fat crystals

The pre-cooled fat-and-oil feedstock optionally mixed with a low melting point fraction is distributed into trays and allowed to stand to form fat crystals. The distribution into each tray is preferably carried out within a short period of time with uniform distribution of crystals. When distribution of a large amount of the pre-cooled fat-and-oil feedstock (or a mixture thereof with a low melting point fraction) takes place within a short period, one of the preferred methods is to divide the pre-cooled fat-and-oil feedstock in a large container into small portions with vertical partitions and to distribute the portions in parallel into crystallization trays arranged in a multi-stage shelf. More specifically, for example, a large container is divided into small spaces with vertical partitions which communicate with each other at a certain height from the bottom of the container to form several compartments. Each compartment has an upper opening from which the pre-cooled fat-and-oil feedstock is distributed into the compartment. The fat-and-oil feedstock is poured into the large container and is over-flowed from the upper part of the compartments to uniformly fill up respective compartments. Thus, the feedstock is uniformly divided into small portions. Then, the feedstock divided into small portions is fed into crystallization trays in parallel and simultaneously through distribution pipes connected to the bottoms of respective compartments (each distribution pipe is provided with a valve which can open and close in parallel with other valves by a mechanical or electronic means). When one distribution pipe is used to distribute a large amount of the pre-cooled feedstock or a mixture thereof with a low melting point fraction into plural trays one by one (the conventional process has employed a method such that a precooled fat-and-oil feedstock is distributed into a tray placed on an uppermost stage so as to overflow from the tray to other trays placed on lower stages one by one), this procedure is time-consuming and crystallization takes place during the distribution, which varies the quality and, in extreme cases,

makes the distribution difficult.

After completion of distribution, the formation of fat crystals is carried out by allowing the trays to stand with the aid of a cooling medium at 18 to 21°C. When air adjusted to a certain constant temperature is ventilated from the side of trays placed on a multi-stage shelf, in comparison with allowing to stand as such without any cooling medium, more constant and reliable crystallization can be carried out. Although the cooling medium is not limited to air, when a liquid cooling medium is used more precise temperature control is required because of its larger thermal conductivity. In addition, as described hereinafter, since the time requiring for formation of fat crystals can be reduced by precooling and using a cooling medium, it is possible to carry out continuous crystallization by placing trays on a conveyer without any large-scale facilities.

The formation of fat crystals is carried out by allowing the trays to stand until the iodine value (IV) of a fractionated low melting point fraction (palm kernel olein) reaches about 23 or higher in the case of PKO. Even if the crystallization by standing is carried out until the IV reaches 25 or higher, the desired slurry can be prepared by subsequent crushing or smashing and therefore a high yield of PKS can be achieved. Normally, the time required for the crystallization by allowing the trays to stand can be reduced to 4 to 6 hours, while trays are generally allowed to stand for about 10 hours for crystallization in the conventional process. It is considered that this reduction in the time required for the crystallization results from a synergistic effect of improvement in the emission efficiency of latent heat of crystallization due to convection of the system which is facilitated by a higher content of liquid components in the system as well as formation of nuclei for crystallization at an early stage due to the low pre-cooling temperature.

Crushing or smashing

After the crystallization, cakes containing fat crystals are taken out of the trays and passed through a crusher. The cakes passed through the crusher become a slurry having fluidity. Therefore, it can be transferred to the pressing step through a pipeline. The crushing or smashing can be carried out by a known method *per se* such as, for example, that described in JP-A 2-14290.

Pressing and separation of solids from the liquid phase

The separation of solids from the liquid phase can be carried out by a known *per se* method. As described above, the cakes containing fat crystals are in the form of a slurry, and it can be transferred through a pipeline, which makes it possible to utilize a filter press which is efficient and suitable for automation.

By this separation step, the fat-and-oil feedstock is fractionated into high and low melting point fractions. The yield of the high melting point fraction is higher than that of the conventional process and the quality thereof is the same as or higher than that of the conventional process.

Since the low melting point fraction thus fractionated is recycled and mixed with the fat-and-oil feedstock, the amount to be treated is by that much increased. However, the low melting point fraction is a liquid component and readily passes through a filter cloth. Therefore, it scarcely a affects the treatment time.

The following Examples and Comparative Examples further illustrate the present invention in detail but are not to be construed to limit the scope thereof. In the Examples and Comparative Examples, all the "percents" are by weight unless otherwise stated.

Example 1

RBD-PKO (refined bleached deodorized - palm kernel oil, SFI at 20°C: 39) heated at 40°C (75 litres) was placed in a jacketed pre-cooling tank and cooled with stirring to 21°C by passing through cold water at 14°C through the jacket. Then, it was distributed into stainless trays each of which was 100 cm in length x 150 cm in width x 8 cm in height in an amount corresponding to a 50 mm depth. The trays were cooled by ventilating cold air at 21°C on both upper and bottom surfaces of irrespective trays at a rate of 3 m/sec for 4 hours. The solidified oil was crushed to prepare a slurry and pressed into a filter press having filtration chambers 15 mm thick. The slurry was pressed at the maximum pressure of 30 kg/cm^2 for 30 minutes to separate solids from the liquid phase. Then, IV values of PKS and PKL were analyzed. As a result, the IV values were 6.98 and 22.7, respectively (see Table 1). Since the yield was as low as 29.9, the same procedure was repeated except that the cooling was carried out for 6 hours. As a result, the yield was increased to 33.1. However, the slurry had less fluidity and, although the filter press was barely used, the industrial scale production by using this procedure would be considered to be difficult.

Example 2

RBO-PKO (48.8 litres) heated to 40°C and PKL (26.6 litres) were mixed and placed in a jacketed pre-cooling tank

and cold water at 14°C was passed through the jacket to cool to 21°C. Then, the mixture was worked up according to the same procedure as that described in Example 1. The results are shown in Table 1.

Example 3 and Comparative Example 1

The difference in cooling temperatures was investigated. Specifically, RBO-PKO (37.5 litres) heated to 40°C and PKL (37.5 litres) were mixed and placed in a jacketed pre-cooling tank and cold water at 14°C was passed through the jacket to cool to 20°C, 22°C, 24°C or 27°C. Then, the mixture was worked up according to the same procedure as that described in Example 1. The IV values of the resultant PKS fractions were 6.52, 6.55, 6.51 and 7.52, respectively and the IV values of the resultant PKL fractions were 25.6, 25.5, 25.2 and 24.6, respectively (see Table 1).

These results suggest that, when the pre-cooling temperature is lower, the crystallization time becomes shorter.

Example 4

According to the same procedure as that described in Example 1, the fractionation was carried out except that 70% by weight of PKL was mixed with PKO. The results are shown in Table 1. As a reference, the estimated values of the conventional process are also shown in Table 1.

Table 1

	Mixing proportion of PKL (%)	Precooling end temp. (°C)	Crystallization time (hours)	IV of PKS	Yield of PKS (%)	IV of PKL
Ex. 1	0	21	4	6.98	29.9	22.7
"	0	21	6	7.19	33.1	23.5
Ex. 2	35	21	4	6.22	30.9	23.5
"	35	21	6	6.55	35.9	25.0
Ex. 3	50	20	6	6.52	39.8	25.6
"	50	22	6	6.55	39.1	25.5
"	50	24	6	6.51	36.4	25.2
Comp. Ex. 1	50	27	6	7.52	32.8	24.6
Ex. 4	70	19	1.5	6.61	30.7	25.0
Conventional	0	27	10	7.0-7.5	32.0	23.0

As described hereinabove, a filter press can be empioyed in the dry fractionation of fats and oils by recycling a low melting point fraction and lowering the pre-cooling temperature. Thereby, it is possible to save manpower and to obtain products having consistent quality. In addition, it is possible to improve the yields of PKS over those of the conventional process.

Claims

1. A process for the dry fractionation of fats and oils which comprises allowing a fat-and-oil feedstock having SFI at 20°C of, at least, 15 to stand to form fat crystals and to obtain cakes containing fat crystals and subjecting the cakes to separation of solids from the liquid phase, said fat and-oil feedstock which is to be allowed to stand being pre-cooled to a temperature of, at the highest, 3°C higher than that of a cooling medium used for the crystallization.

2. A process according to claim 1, wherein a low melting point fraction separated as the liquid phase is recycled and mixed with the fat-and-oil feedstock.

3. A process according to claim 1 or claim 2, wherein the fat and-oil feedstock is a laurin fat or oil.

4. A process according to claim 2 or claim 3, wherein the low melting point fraction is mixed with the fat-and-oil feedstock in a proportion of at least 30% by weight of the total amount of the resultant mixed fats and oils.

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EUROPEAN SEARCH REPORT

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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 5 401 867 A (SITZMANN WERNER ET AL) 28 March 1995 * column 5, line 30 - column 8, line 59 * * example 3 * * claims 1,5-9,31-34 *	1,3	C11B7/00
Y		2,4	
Y	EP 0 399 597 A (UNILEVER NV ;UNILEVER PLC (GB)) 28 November 1990 * page 4, line 26 - line 30 * * claims 1,7,8 *	2,4	
A	EP 0 262 113 A (TIRTIAUX FRACTIONNEMENT) 30 March 1988 * page 4, column 5, line 51 - line 56 * * claim 1 *	1	
A	DATABASE WPI Section Ch, Week 8849 Derwent Publications Ltd., London, GB; Class D23, AN 88-348856 XP002075816 -& JP 63 258 994 A (FUJI OIL CO LTD) * abstract *	1,2,4	TECHNICAL FIELDS SEARCHED (Int.Cl.6) C11B
D,A	GB 2 220 672 A (FUJI OIL CO LTD) 17 January 1990 * the whole document *	1	
A	GB 2 180 253 A (ALFA LAVAL FOOD & DAIRY ENG) 25 March 1987 * the whole document *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28 August 1998	Dekeirel, M

CATEGORY OF CITED DOCUMENTS

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